International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(3): 96-100
www.biochemjournal.com
Received: 08-11-2023
Accepted: 21-12-2023

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Effect of feeding ginger powder on performance and carcass traits of broiler chicken

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DOI: https://doi.org/10.33545/26174693.2024.v8.i3Sb.699

Abstract
An experimental investigation was conducted to assess the effects of powdered ginger (*Zingiber officinale*) as a natural dietary supplement on the growth and carcass attributes of broiler chickens. Eighty-one commercial broiler chicks of the Ven Cobb Strain were randomly distributed into four treatment groups, including a control group, with three replicates of fifteen chicks each. Throughout the six-week experimental period, the chicks were reared in a deep litter system under uniform care and management practices, with ad libitum access to water and feed. Four experimental diets were formulated as follows: T_0, comprising the standard broiler ration in accordance with BIS (1992) standards, served as the control group; T_1 contained the standard broiler ration supplemented with 0.5% ginger powder; T_2 included the standard broiler ration supplemented with 1% ginger powder; and T_3 consisted of the standard broiler ration supplemented with 1.5% ginger powder. The treatment groups, T_0, T_1, T_2, and T_3, exhibited cumulative average body weights of 2063.33 g, 2193.67 g, 2243.67 g, and 2187.67 g, respectively, at the conclusion of the sixth week, indicating significant differences ($p<0.05$) in body weight. However, the average weekly body weight gain did not exhibit significant differences among the dietary treatments. In comparison to treatment groups T_1 (3579.71 g) and T_3 (3543.48 g), with the lowest in T_2 (3443.73 g), group T_0 exhibited significantly greater average feed consumption at 3690.11 g ($p<0.01$). Treatment group T_2, supplemented with 1% ginger powder, demonstrated a notably higher feed conversion ratio compared to the other groups ($p<0.05$). Among the treatment groups, T_2 (1706.66 g) showed the highest carcass weight, followed by T_3 (1652.53 g), T_1 (1647.80 g), and T_0 (1531.41 g). Broilers in the T_2 group exhibited significantly greater carcass weight compared to those in groups T_0, T_1, and T_3 ($p<0.05$). The treatment group T_2, supplemented with 1% ginger powder, exhibited the highest edible meat percentage (76.08%), followed by T_3 (75.53%), T_1 (75.11%), and T_0 (74.22%). Broilers in the T_2 group demonstrated significantly increased giblet weight compared to those in groups T_0, T_1, and T_3 ($p<0.05$). The research findings suggest that supplementing broiler diets with 1% ginger powder enhances broiler performance, as evidenced by improvements in cumulative average body weight, feed conversion ratio, and carcass weight.

Keywords: Broiler performance, ginger powder, feed additive, carcass traits

Introduction

Various feed additives are employed to optimize nutrient availability and utilization, enhance the utilization of feed ingredients, and augment chicken growth and production performance with the aim of maximizing profitability. These additives play a role in improving health or nutrient metabolism, expediting development, and optimizing feed utilization (Church and Pond, 1988) [7]. Certain feed additives act as growth promoters and disease preventatives, encompassing antibiotics, coccidiostats, antioxidants, enzymes, hormones, probiotics, buffers, organic acids, mold inhibitors, herbal supplements, synthetic micronutrients, and other similar substances. The utilization of growth promoters containing antibiotics has come under scrutiny globally, prompted by findings indicating adverse effects such as the development of microbial resistance to these drugs and potential risks to human health (Rahmatnejad *et al*., 2009) [19]. Researchers in the field of poultry science are actively seeking safer alternatives to antibiotics for promoting growth that do not pose harm to both birds and humans. Over the past decade, there has been increasing interest in the use of natural herbs and medicinal plants as feed additives in poultry diets to enhance production potential (Khan *et al*., 2012) [12].

The feasibility of herbal compounds serving as safer alternatives to conventional growth promoters is supported by their suitability, palatability, cost-effectiveness in production, minimal toxicity, and limited health risks. Certain herbal additives contain components that stimulate the synthesis of digestive juices, thereby enhancing digestion and appetite (Baretto *et al*., 2008) [4]. Additionally, these additives serve as immunostimulants without compromising developmental processes (Nidaullah *et al*., 2010) [16]. Among the notable herbal feed supplements are thyme, ginger, garlic, and fenugreek, among others. While comprehensive scientific investigations on most of these herbal remedies are lacking, their historical usage suggests potential safety and efficacy. Feeding ginger (*Zingiber officinale*) led to a reduction in total feed intake and an increase in body weight. As reported by Herawati (2010) [10], the inclusion of 2% ginger in chicken diets resulted in elevated body weight, decreased total feed intake, and minimal alterations in the morphology of muscle, liver, kidney, and proventriculus tissues. Ginger contains active constituents such as gingerol, shogaols, gingerdiol, and gingerdione (Kikuzaki and Nakatani, 1996) [14]. The increasing popularity of ginger is attributed to its diverse benefits, which encompass cholesterol reduction and enhancement of nutritional quality in animal products, leading to increased output of meat, milk, or eggs. Rhizomes like ginger hold significant promise for various medicinal applications. Numerous formulations, dosages, and administration timings have been explored for the utilization of ginger in broiler and layer diets (Khan *et al*., 2012) [12]. The present investigation aimed to assess the impact of ginger (*Zingiber officinale*) powder on growth performance metrics (including body weight gain, feed intake, and feed conversion ratio) as well as carcass characteristics (comprising live weight, carcass weight, edible meat percentage, and giblet weight), with a focus on the importance of herbal feed supplements.

Materials and Methods

For a duration of 42 days (6 weeks), a study was conducted on 180 1-day-old Vencobb straight-run commercial grill chicks. The chicks were from M/s Yogeshwari Hatcheries PVT. LTD. in Jaynagar, Maharashtra's Beed district, Parli Vaijnath. The floor, pens, waterers, feeders, and brooders were all cleaned, washed, disinfected, and fumigated prior to the arrival of the broiler chicks. Upon arrival, the chicks were individually weighed and subsequently allocated into three treatment groups: T_1 (45.13±0.43 g), T_2 (45.41±0.10 g), and T_3 (44.99±0.10 g), each consisting of three replicates with 15 chicks per replicate, along with one control group, T_0 (45.79±0.11 g), utilizing a Complete Randomized Design (CRD). The experimental setup was conducted at the College of Veterinary and Animal Sciences, Department of Animal Nutrition, MAFSU, located in Parbhani, Maharashtra State, India. The ginger powder was sourced from the local market. Rice husk and sawdust served as the litter materials in the deep litter system utilized for housing the birds. Uniform management practices, including feeding, watering, and lighting, were maintained across all experimental groups throughout the duration of the trial. Each of the four experimental enclosures housing the chicks had a floor area of one square foot.

Each pen was partitioned to accommodate three replications for each treatment group. Four experimental diets were formulated: the control group (T_0) received the standard broiler ration according to BIS (1992) [6] standards, while T_1, T_2, and T_3 groups were supplemented with 0.5%, 1%, and 1.5% ginger powder, respectively, added to the standard broiler ration.

Electric hover brooders were utilized for brooding purposes to provide both light and warmth. Brooding was conducted within each respective pen for every replication and treatment group until the birds reached two weeks of age. Subsequently, adequate nighttime illumination was provided to all birds. Throughout the experimental period, birds were provided with ad libitum access to fresh, clean, and chilled drinking water. Upon hatching, all experimental chicks received vaccinations against Marek's disease on their first day, Newcastle disease on days seven and eight, and Gumboro disease on days fourteen and twenty-four. For the initial two days post-hatch, all broiler chicks were provided with ground corn feed. From the third day onwards, they were transitioned to experimental diets formulated in accordance with BIS (1992) [6] guidelines. Feeding of all groups was ad libitum throughout the duration of the study.

Table 1: Percent composition of standard broiler rations as per BIS (1992) [6]

Sr. No.	Particulars	Control Group	
		Starter	Finisher
1.	Maize	52.8	60.3
2.	Soyabean meal	36	28.85
3.	Meat bone meal	3.5	3.1
4.	Vegetable oil	1	1
5.	Methionine	0.9	0.8
6.	Lysine	1.2	1.2
7.	Limestone powder	1.65	1
8.	Di-Calcium Phosphate	1.5	1.5
9.	Salt	0.4	0.4
10.	Trace Mineral Mix.	0.4	0.4
11.	Vitamin Mix.	0.3	0.3
12.	Choline choride	0.15	0.15
	Total	100	100
	Protein	23.06	20.09
	M.E.Kcal/Kg	2800.14	2899.65
	E:P ratio	121.59:1	145.17:1

Throughout the study period, data on average weekly body weight and weight gain per bird, average daily feed intake, average weekly feed intake, and cumulative weekly feed intake per bird were collected. Additionally, weekly cumulative feed conversion ratio, weekly feed conversion ratio per bird, and weekly body weight per bird were calculated. At the termination of the experiment, six birds from each group were euthanized by severing the carotid artery and jugular vein at the base of the bird's head after carefully placing the head. Subsequently, the birds underwent scalding using a series of online plucking machines, followed by automatic defeathering. Manual evisceration was performed to assess carcass characteristics, as described by Gracy (1999) [10]. The percentage of edible flesh was determined by dividing the carcass weight by the live weight of the bird. Giblet weight was calculated as the sum of the weights of the liver, gizzard, and heart. Chemical analyses of the experimental broiler diets for all proximate principles were conducted following the protocols outlined in AOAC (1995) [3]. Statistical analysis of the data collected during this experiment was performed using the Complete Randomized Design (CRD) approach, as described by

Snedecor and Cochran (1994) [21]. Week and treatment were considered as the two factors in the analysis.

Results and Discussion

The proximate composition of the starter and finisher rations for the four experimental groups was analyzed following AOAC (1995) [3] guidelines, as presented in Table 2. The results indicate that the experimental starter and finisher feeds meet the nutritional requirements outlined by BIS (1992) [6] for broilers, ensuring adequate nutrient provision for growth.

Table 2: Percent chemical composition of experimental starter ration on dry matter basis

Nutrients	Percent in ration							
	T_0 (control)		T_1		T_2		T_3	
	Starter	Finisher	Starter	Finisher	Starter	Finisher	Starter	Finisher
Crude protein	23.18	20.30	23.30	20.27	22.12	20.19	22.24	20.28
Crude fiber	2.85	3.20	2.61	3.43	2.55	3.45	2.20	3.53
Ether extract	3.36	3.44	3.52	3.27	3.40	3.40	3.56	3.36
Total ash	6.10	6.30	6.61	6.31	6.97	6.09	6.13	6.90
Acid insoluble ash	1.90	2.05	1.76	2.15	1.83	2.10	1.80	2.12
Nitrogen free extract	64.60	66.76	64.96	66.84	63.87	67.79	63.03	67.02
Calcium	1.09	1.07	1.11	1.16	1.12	1.14	1.10	1.17
Phosphorus	0.60	0.62	0.86	0.97	0.91	0.96	0.90	0.99
ME Kcal/kg	2822.50	2910.15	2820.50	2918.05	2795	2896.50	2785	2896.10

Cumulative body weight

Weekly body weight measurements were utilized to assess the growth performance of the experimental birds. Analysis presented in Table 5 indicates that, at the initiation of the experiment, there were no significant differences observed among treatment groups in terms of the average weekly cumulative body weight of the experimental birds fed various diets. However, by the end of the fourth week, the experimental birds in the T_2 group exhibited significantly greater body weights compared to those in the T_0, T_1, and T_3 groups ($p<0.05$).

However, there were no significant differences observed in the average weekly cumulative body weight of the experimental birds among the T_0 (control), T_1, and T_3 groups. In contrast, the T_2 group (2243.67 g) demonstrated a significantly higher body weight compared to the T_0 (2063.33 g), T_1 (2193.67 g), and T_3 (2187.67 g) groups at the end of the sixth week ($p<0.05$). These findings align with previous studies by Herawati (2010) [10], Arshad *et al.* (2012) [2], and Rafiee *et al.* (2014) [18], which reported significant improvements in body weight gain in broilers supplemented with ginger powder ($p<0.05$). Contrary to the findings of Fakhim *et al.* (2013) [9], which indicated no significant difference among treatment groups when ginger powder was incorporated into the diet, the present results diverge. Additionally, according to Al-Moramadhi (2010) [1], the supplementation of ginger root infusion does not exert any discernible impact on body weight.

Average Weekly Gain in Body Weight

As the sixth week concluded, no statistically significant difference ($p<0.05$) was observed between the treatment and control groups. Furthermore, findings from studies conducted by Kehinde *et al.* (2011) [11] and Arshad *et al.* (2012) [2] revealed no significant alterations in weekly body weight gain among broilers supplemented with ginger powder, contrasting with the outcomes of the present investigation.

Weekly Feed Consumption

Throughout the six-week trial, the feed intake of the broiler chicks was monitored on a weekly basis, and Table 6 presents the average weekly feed consumption data. By the conclusion of the second week, there was a significant variation ($p<0.05$) in the weekly feed consumption per experimental bird between the treatment and control groups. At the end of the third week, feed intake values were 540.04 g, 551.42 g, 539.20 g, and 541.33 g for T_0, T_1, T_2, and T_3 groups, respectively, with no significant difference observed ($p>0.05$). A significant difference ($p<0.05$) in feed intake per bird was observed in the fourth week between experimental group T_2 and the remaining three groups (T_0, T_1, and T_3). By the conclusion of the fifth week, the feed intake of the T_0 group differed significantly ($p<0.05$) from that of the T_1, T_2, and T_3 groups. However, by the end of the sixth week, no discernible difference in weekly feed intake per bird was noted between the treatment and control groups. Birds in the T_0 group consumed significantly more feed compared to the T_1, T_2, and T_3 groups ($p<0.05$). The findings of the current study may be analogous to those reported by Arshad *et al.* (2012) [2], who administered ginger extract to broiler chicks via their drinking water.

The feed intake among groups T_0, T_1, T_2, and T_3 showed similar patterns, which aligns partially with the results of Zomrawi *et al.* (2013) [23], indicating that birds fed diets containing 1.5% and 2% powdered ginger root exhibited reduced feed consumption. The current study's findings are consistent with those reported by Barazesh *et al.* (2013) [5] and Rafiee *et al.* (2013) [17], who observed a significant ($p<0.05$) decrease in feed intake during the second week following administration of 1% ginger powder to broiler chickens compared to the control group. Additionally, it was discovered that the maximum intake was seen in the sixth week of therapy with 0.5% ginger powder and the lowest with 1% treatment. Al-Moramadhi (2010) [1], Kehinde *et al.* (2011) [11], and Fakhim *et al.* (2013) [9], on the other hand, noticed contradicting results, reporting that there was no difference in feed consumption between treatment groups.

Table 5: Average weekly body weight (g) of broilers at different ag

Age in weeks	Treatments				CD
	T_0	T_1	T_2	T_3	
Average weekly body weight (g) of broilers at different age					
Initial Weight	45.79±0.11	45.13±0.43	45.41±0.10	44.99±0.10	NS
1st	164.09±2.00	170.38±2.83	167.58±2.95	166.47±1.12	NS
2nd	422.07±4.34	431.87±10.35	439.80±7.44	431.07±6.87	NS
3rd	780.44±4.29	806.22±7.27	798.44±11.89	799.56±12.95	NS
4th	1167.53^b±17.70	1230.78^a±16.36	1239.00^a±9.02	1198.18^{ab}±11.29	45.827
5th	1610.00±20.53	1695.00±12.22	1720.02±12.72	1680.86±40.42	NS
6th	2063.33^b±24.44	2193.67^a±25.12	2243.67^a±14.84	2187.67^a±54.91	108.94
Average weekly gain in body weight (g) per bird of broilers at different age					
1st	118.30±2.09	125.24±2.48	122.16±2.85	121.47±1.21	NS
2nd	257.98±4.19	261.49±12.39	272.22±6.20	264.60±5.78	NS
3rd	358.38±1.85	374.36±6.19	358.64±4.83	368.49±6.55	NS
4th	387.09±20.14	424.56±15.60	440.56±11.16	398.62±23.40	NS
5th	442.47±3.07	464.22±10.79	481.02±15.71	482.68±29.14	NS
6th	453.33±4.48	498.67±25.69	523.64±11.45	506.81±15.27	NS
Average Weekly feed consumption (g) per bird of broilers at different age					
1st	113.84±2.48	148.64±14.99	139.36±2.34	130.87±2.86	NS
2nd	383.40^a±17.81	339.69^b±6.89	342.64^b±6.56	339.51^b±1.53	32.982
3rd	540.04±2.34	551.42±10.06	539.20±13.22	541.33±8.13	NS
4th	732.82^a±7.61	750.93^a±11.59	635.51^b±26.96	731.33^a±18.03	57.523
5th	956.67^a±3.33	843.69^b±18.33	847.02^b±20.58	840.44^b±10.46	48.376
6th	963.33±13.33	945.33±7.67	940.00±4.62	960.00±3.46	NS
Total	3690.11±25.03	3579.71±66.30	3443.73±60.36	3543.48±24.26	155.411
Average weekly FCR of experimental birds at different age					
1st	0.96±0.04	1.19±0.14	1.14±0.02	1.08±0.01	NS
2nd	1.48^a±0.05	1.30^b±0.04	1.26^b±0.01	1.28^b±0.02	0.103
3rd	1.51±0.01	1.47±0.05	1.50±0.02	1.47±0.00	NS
4th	1.90±0.08	1.77±0.08	1.45±0.10	1.85±0.15	NS
5th	2.16^a±0.02	1.82^b±0.06	1.77^b±0.09	1.75^b±0.09	0.225
6th	2.13^a±0.05	1.90^b±0.09	1.80^b±0.05	1.90^b±0.06	0.202
Mean at end of 6th week	1.69±0.03	1.58±0.05	1.49±0.03	1.56±0.05	NS

NS: Non significant

Note: The means bearing superscripts a and b in the row differ significantly ($p<0.05$)

Feed Conversion Ratio

The weekly feed conversion ratio for the first six weeks was calculated based on the average weekly body weight gain and weekly feed consumption, as presented in Table 7. At the end of the sixth week, the mean feed conversion ratio for treatment group T_2 (1.49) was significantly higher ($p<0.05$) compared to both T_0 (1.69) and T_1 (1.58) groups. However, by the conclusion of the first week, no significant difference ($p>0.05$) in the feed conversion ratio was observed between the treatment and control groups. Significant differences ($p<0.05$) in feed conversion ratio (FCR) were observed between the treatment groups (T_1, T_2, and T_3) and the control group (T_0) at the end of the second, fifth, and sixth weeks. Particularly during the penultimate week of the trial and overall, birds fed diets supplemented with one and one-half percent powdered ginger exhibited significantly higher FCR values in this study ($p<0.05$). These findings are consistent with those reported by Mohamed *et al*. (2012) [15], who noted a significant decrease in FCR for birds fed diets containing 0.2% ginger ($p<0.05$). The results of Herawati (2010) [10] and Fakhim *et al*. (2013) [9], who showed a substantial ($p<0.05$) difference between treatments, are supported by the current data. Shanoon *et al*. (2012) [20] and Rafiee *et al*. (2013) [17], on the other hand, reported inconsistent findings and found no discernible difference in FCR between the therapies.

Carcass traits

Table 6 results revealed a significant difference ($p<0.05$) in live weight between the control group T_0 and treatment groups T_1, T_2, and T_3. Contrary to the findings of Zomrawi *et al*. (2012) [22], who reported significantly lower pre-slaughter weights in animals treated with 0.5% ginger powder compared to other treatments, the present study yielded different results. Notably, treatment group T_2 exhibited the highest carcass weight among all groups. The results of Fakhim *et al*. (2013) [9], who found a substantial ($p<0.05$) difference between treatments, were identical to these. Results revealed that treatments had no significant effect on the proportion of edible meat. The proportion of edible meat found in the current study's results is consistent with that found by Zomrawi *et al*. (2012) [22] after feeding ginger power. Giblet weight changes were found to be significant ($p<0.05$) for treatment groups T_1, T_2, and T_3, as well as for control group T_0. The current study's giblet weight results are consistent with those of Rafiee *et al*. (2014) [18], who found that the T_2 (0.2 percent ginger powder) group's giblet weight rose considerably ($p<0.05$) when compared to the control group. Contradictory findings, however, were reported by Barazesh *et al*. (2013) [5], who found no discernible difference in giblet weight across the treatment groups.

Table 6: Carcass Traits of Experimental Birds

Parameter	Treatments Groups				CD
	T_0	T_1	T_2	T_3	
Live Weight (g)	2063.50^{b} ±23.06	2193.83^{a} ±25.03	2243.67^{a} ±70.00	2187.67^{ab} ±36.05	126.524
Carcass Weight (g)	1531.41^{b} ±16.32	1647.80^{a} ±21.81	1706.66^{a} ±54.13	1652.53^{a} ±35.14	103.325
Edible meat percentage	74.22±0.40	75.11±0.43	76.08±0.68	75.53±0.78	NS
Giblet weight (g)	96.91^{ab} ±1.93	91.37^{b} ±4.29	104.43^{a} ±3.06	90.43^{b} ±2.98	9.376

NS: Non significant

Note: The means bearing different superscript (a, b and ab) in the row differ significantly (p<0.05)

Conclusion

The study titled "Effect of feeding ginger (*Zingiber officinale*) powder on performance and carcass traits of broiler chicken" was conducted to assess the influence of ginger supplementation on growth performance, feed consumption, feed conversion ratio, and carcass characteristics in broiler production. The incorporation of one percent powdered ginger (*Zingiber officinale*) in broiler diets was found to be beneficial in enhancing cumulative body weights. The inclusion of powdered ginger (*Zingiber officinale*) in the broiler diet did not influence the weekly body weight growth of the animals. However, supplementation with powdered ginger (*Zingiber officinale*) improved the feed conversion ratio of the broiler diets. Incorporating powdered ginger (*Zingiber officinale*) as a herbal feed supplement in the broiler diet resulted in enhanced carcass characteristics of the animals.

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